
ACCLIMATIZATION OF AMERICAN FISHES IN ARGENTINA



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During the latter part of 1903 the Government of Argentina, having determined upon investigations as to the possibilities of practical fish culture in that country, employed Mr. John W. Titcomb, chief of the division of fish culture in the United States Bureau of Fisheries, to inaugurate the undertaking. Mr. Titcomb was engaged in the work some eight or nine months, and during this period arranged for the introduction of several species of fish from the United States. He also chose the site for the first hatchery at Lago Nahuel Huapi, situated in the Andes Mountains, within 2 or 3 miles of the Chilean boundary.

Actual fish cultural work was begun in Argentina March 4, 1904, with the arrival at Lago Nahuel Huapí of a consignment of fish eggs with which I had left New York January 19. From Buenos Aires I brought also the necessary equipment for a small temporary hatchery, the latter having been planned by Mr. Titcomb and nearly finished under his direction before he left the lake. The first part of the journey, from Buenos Aires to Neuquen, was made by train, the time occupied being two nights and one day. From Neuquen to Lago Nahuel Huapí, a distance of 300 miles, the eggs and hatchery equipment were carried in wagons, the members of the party accompanying on horseback.

The consignment of eggs consisted, in New York, of the following: One million whitefish (*Coregonus clupeiformis*), 100,000 brook trout (*Salvelinus fontinalis*), 53,000 lake trout (*Cristivomer namaycush*), and 50,000 landlocked salmon (*Salmo salar sebago*). The loss in the entire lot of eggs, from the time they left New York until their hatching was completed, was less than 10 per cent. The loss in the lake trout was only about 5 per cent, and the same in one lot of brook trout, while the other 50,000 lot of this species began hatching before reaching their destination, thereby causing a loss of about 30 per cent. The loss of landlocked salmon was about 10 per cent, while the loss of whitefish to the day their distribution was concluded had been only 10 per cent. This consignment of eggs produced a great many more fry than we expected, and it became necessary to move the hatching troughs and fish immediately

to a site about 3 miles away, where were found springs from which would flow at least ten times more water than those at the first location. The hatchery on this site has since been pulled down and rebuilt on a much larger scale.

We liberated 900,000 strong, healthy whitefish fry in Lago Nahuel Huapí within a month after the arrival of the eggs at the hatchery. Up to the present time, however, no specimens of the whitefish have been secured for unmistakable identification, owing, probably, to the fact that we have not yet been able to fish systematically for them with suitable boats and nets. A supposed whitefish was caught in a small seine about a year ago by an "estanciero" living on the shore of the lake.

The majority of the lake trout, as also the greater number of the landlocked salmon, were planted in the lakes Nahuel Huapí, Traful, Gutierrez, and Correntosa. Lago Traful is about 45 miles from Lago Nahuel Huapí, and is about 30 miles long, but probably not more than 5 wide at greatest width, and very narrow at other points. Lago Gutierrez and Lago Correntosa are connected with Lago Nahuel Huapí by short streams. Both lakes are about 10 miles long, with an average of 2 to 4 miles in width. The larger proportion of the brook trout were planted in a number of small rivers and streams flowing into these lakes, as well as in tributaries to the Rio Limay and Rio Traful. The Rio Limay flows out of Lago Nahuel Huapí, and the Rio Traful out of Lago Traful, and empties into the Rio Limay.

Lake trout have been found in Lago Traful and Lago Correntosa, and landlocked salmon in Lago Gutierrez, while brook trout have been found in nearly all of the rivers and brooks stocked. In many of these the brook trout are very numerous and are increasing rapidly. The superintendent and assistants of the Nahuel Huapí hatchery took, both last year and this, thousands of fingerlings from irrigating ditches which receive their water from these streams, and replanted them in the brooks. Only last April 860 brook trout fingerlings were taken from a small garden-irrigating ditch heading in the "arroyo de Jones," and 2,300 from another heading in the "arroyo de Newbery." These were undoubtedly fingerlings hatched in September or October, 1907.

On March 1, 1905, the fish in the ponds at the Nahuel Huapí hatchery were counted, and there were found to be 8,500 brook trout, 3,800 lake trout, and 1,800 landlocked salmon. They measured from 6 to 8 inches in length. A large number were accidentally lost during the latter part of the year, but in May, 1906, we had a considerable number of each of these species in the ponds. The death rate in all three from the time hatched, in March, 1904, until now was as low as would have been found at any one of the more successful trout hatcheries in the United States. During this month (May) about 50,000 brook trout eggs were collected from stock fish, and the loss on the lot during the hatching period was but 4 per cent. The alevins hatched were strong

and healthy, and later turned out a robust lot of fry, the loss being less than 5 per cent during the next four months.

During May and June, 1907, 270,000 brook trout eggs were collected at the Nahuel Huapí hatchery. They were hatched with an average loss of 15 per cent. On June 21 140,000 of these eggs were eyed and started down the Rio Limay to Neuquen in a small boat, and brought from Neuquen to La Cumbre, in the Province of Córdoba, via Buenos Aires, by rail. They arrived at the La Cumbre hatchery July 7, with a loss en route of 2 per cent, and were hatched with a further loss of 4 per cent. The fry loss was not large, not taking into account the killing of a large number by accident. Plants of fry were made during the latter part of August and all of September, in various bodies of water in the provinces of Córdoba, Buenos Aires, Tucuman, Salta, and San Luis.

La Cumbre is in the Córdoba Mountains, an inland range, and about eighteen hours from Buenos Aires by train. The elevation is about 4,100 feet.

I have not yet had time to make a systematic investigation of the waters stocked with the fish hatched from the 40,000 brook trout eggs at La Cumbre, but have been told that trout do exist in several of these bodies of water; and I know that splendid results have been obtained from a plant of 200, made the last of September, in what is known as the Lumsdaine "dique." This is a small pond from 130 to 150 feet in diameter, nearly round, with a maximum depth of 10 feet in its deepest part when full, which is seldom. The water for filling this pond is brought from a very small mountain stream in an open ditch, which is from one-half to three-fourths of a mile long and into which the sun shines all day. The minimum flow of this stream is 35 gallons of water per minute, and the ponds receive it all during the first ten days in each month, but only 5 gallons per minute during the rest of the month. The maximum temperature of the water in this stream is 75° to 77° F. at noon on a hot summer's day, but usually drops back to from 60° to 65° F. at night. I do not know the temperature of the water in the ditch where it empties into the pond at midday in summer, but judge it reaches a temperature as high as 80° to 85° F. I presume the temperature of the water in the bottom of the pond is about 74° to 78° F. at this time.

On July 31, 1908, about one year after these trout were hatched, there were in this pond from 125 to 150 as fine and healthy brook trout as I have ever seen. The only artificial food they have ever had was during about one month when held in the rearing troughs. Since being liberated they have had only the natural food found in this pond; notwithstanding which all are now from 7 to 10 inches in length.

It is hoped that about one-half million of brook trout eggs and a few thousand of landlocked salmon eggs will be collected at the Nahuel Huapí hatchery this

season. By May 31 a total of 255,600 brook-trout eggs had been secured. About the first of June 63,000 eyed eggs of this lot were sent to Buenos Aires, and from this city 23,000 were sent to the La Cumbre hatchery, and 40,000 to a small temporary hatching plant only recently located near Ledesma, in the Province of Jujuy, the most northerly province of Argentina. A few days later another lot of 25,000 brook trout eggs were shipped from the Nahuel Huapí hatchery to Santiago, Chile, by request of the Chilean Government, to be hatched in a small hatchery belonging to that Government, located in the Andes Mountains, on the railroad which crosses from Buenos Aires to Valparaiso, not far from the Argentine boundary. The eggs shipped to La Cumbre and Ledesma, via Buenos Aires, reached their respective destinations with a loss of less than 3 per cent. Those shipped to La Cumbre were hatched with a very small loss (less than 4 per cent), and the alevins are strong and robust and fast reaching the feeding stage, with a very small percentage of loss. The loss of eggs hatched at Ledesma was larger, owing to the high temperature of the water we were compelled to use for hatching, which was 55° to 60° F., and 8° to 10° F. warmer than at La Cumbre. The loss of alevins at Ledesma has also been rather large to date, owing probably to the same cause; in neither case, however, has the loss been unexpectedly great.

From what we have accomplished with the brook trout at Nahuel Huapí and La Cumbre, I am led to believe that, by gradually breeding them up to it over a period of two or three years, these fish can be successfully reared in very warm water.

The following table shows the small loss of stock fish at the Nahuel Huapí hatchery for the five months ended March 31, 1908:

STATEMENT OF LOSSES OF ADULT FISH AT NAHUEL HUAPÍ HATCHERY FOR FIVE MONTHS ENDED MARCH 31, 1908.

Species.	On hand Oct. 30, 1907.	Deaths from Oct. 30, 1907, to Mar. 31, 1908.	On hand Mar. 31, 1908.
Brook trout (2 to 4 years).....	4,902	53	4,849
Landlocked salmon (4 years).....	70	3	67
Rainbow trout (3 years).....	4	-----	4
Total.....	4,976	56	4,920

Of fingerling and yearling brook trout there were on hand October 30, 1907, 60,950; distributed November 1, 1907, to March 31, 1908, 49,700; loss November 1, 1907, to March 31, 1908, 3,350; on hand March 31, 1908, 8,900.^a

The second shipment of eggs of American fishes to the Argentine Republic resulted rather disastrously. One of the superintendents of this section left New

^a It is in the summer months—December, January, and February—covered by these figures, that the greatest losses occur.

York early in June, 1904, with 20,000 eggs of steelhead trout (*Salmo gairdneri*) and 50,000 rainbow trout (*Salmo irideus*) eggs. Off the coast of Brazil the steelhead eggs commenced hatching rapidly and before reaching Rio Janeiro these had all to be put overboard. The rainbow trout eggs carried very badly, and nearly all were lost by July 23. On this date the few remaining live eggs were planted in Laguna La Grande, as it was deemed impossible to reach the Nahuel Huapí hatchery with any alive.

The third shipment was more successful, although far from satisfactory. Early in January, 1905, one of our superintendents left New York with 300,000 brook trout (*Salvelinus fontinalis*) eggs, 224,000 lake trout (*Cristivomer namaycush*), 100,000 quinnat salmon (*Oncorhynchus tshawytscha*), 92,000 rainbow trout (*Salmo irideus*), and 30,000 landlocked salmon (*Salmo salar sebago*), arriving in Buenos Aires February 4. On arrival in the city, the quinnat salmon eggs were found to be practically all dead, while the larger portion of rainbows were either dead or dying. The landlocked salmon, brook and lake trout were in much better condition, the percentage of loss en route having been comparatively small. The greater portion of the live eggs were taken to the Nahuel Huapí hatchery, where they were hatched with fair success. An attempt was made, however, to hatch a few landlocked salmon, brook and lake trout eggs in a temporary hatching plant erected at Alta Gracia, in the Province of Córdoba. The water to be used was from a small mountain stream, it being hoped that the weather would be sufficiently cold at this time—the latter part of March—to reduce the water temperature here to about 55° F. Unfortunately, however, the weather proved to be as warm as at any time during the entire summer, and consequently the water temperature in this stream would rise to about 75° F. at midday, although usually falling to about 60° F. each night. The hatching plant had been located where there were two small springs whose waters came out of the ground at 62½° F. This water was to be given a trial in case the water in the stream was higher, but water at 62½° F. was found to be entirely too warm for hatching and rearing eggs which had been in refrigerator cases at a temperature of 35° to 38° F. for nearly eighty days. A few thousand fish of each variety were hatched, but had to be planted soon after coming out. It has been reported that some of the trout and landlocked salmon planted here have been caught from time to time, but I have never been able to obtain a specimen of either.

The fourth shipment yielded even better results than the first. On February 10, 1906, I left New York, en route to Argentina via England, with 300,000 quinnat salmon (*Oncorhynchus tshawytscha*) eggs, 122,500 sockeye salmon (*Oncorhynchus nerka*), 98,200 silver salmon (*Oncorhynchus kisutch*), 80,000 lake trout (*Cristivomer namaycush*), 60,000 brook trout (*Salvelinus fontinalis*), 30,000 landlocked salmon (*Salmo salar sebago*), and 25,000 rainbow trout (*Salmo*

irideus). At Southampton, England, on February 23, I received 25,000 Atlantic salmon (*Salmo salar*) eggs from the Earl of Denbigh's fisheries in North Wales. On March 17 I arrived at Buenos Aires, but I was unavoidably delayed here for 10 days. The losses from the time the eggs were packed at the hatcheries in the United States and North Wales until reshipped on March 27, en route to the Santa Cruz hatchery, in southern Argentina, were as follows: Quinнат and sockeye salmon, 1 per cent each; brook and lake trout, the same; silver and landlocked salmon, 2 per cent each; Atlantic salmon, only 5 per cent, while it was 20 per cent on one lot of rainbow and 60 per cent on another. From this time until all of the eggs were hatched, April 30, the losses of eggs and alevins were as follows: Quinнат and silver salmon, only 2 per cent; sockeye salmon, 4 per cent; lake trout and landlocked salmon, only 5 per cent; brook trout, 20 per cent (mostly fish hatched en route because of the delay in Buenos Aires), and Atlantic salmon and rainbow trout, about 50 per cent.

The following table shows the number of each species on hand at the Santa Cruz hatchery May 1, 1906, and again on November 1, 1906, with losses, plants made, etc., during this period (6 months):

RECORD OF SANTA CRUZ HATCHERY, MAY 1 TO NOVEMBER 1, 1906.

Species.	On hand May 1.	Deaths May 1 to Nov 1.	Per cent of loss.	Distributed May 1 to Nov. 1.	On hand Nov. 1.
Quinнат salmon.....	291,000	8,730	3	270,470	11,800
Sockeye salmon.....	116,400	2,330	2	110,470	3,600
Silver salmon.....	94,300	4,715	5	85,185	4,400
Lake trout.....	75,200	2,250	3	68,550	4,400
Brook trout.....	47,500	2,850	6	40,050	4,600
Landlocked salmon.....	27,900	3,070	11	24,040	790
Rainbow trout.....	9,400	750	8	8,400	250
Atlantic salmon.....	11,900	5,900	50	6,000	-----
Total.....	673,600	30,595	-----	613,165	29,840

The following table shows the number of each species on hand at the Santa Cruz hatchery on November 1, 1906, and again on March 1, 1907, with losses, plants made, etc., during this period (4 months):

RECORD OF SANTA CRUZ HATCHERY, NOVEMBER 1, 1906, TO MARCH 1, 1907.

Species.	On hand Nov. 1.	Deaths Nov. 1 to Mar. 1.	Per cent of loss.	Distributed Nov. 1 to Mar. 1.	On hand Mar. 1.
Quinнат salmon.....	11,800	165	1.4	7,000	4,635
Silver salmon.....	4,400	22	.5	1,300	3,078
Sockeye salmon.....	3,600	20	.56	-----	3,580
Brook trout.....	4,600	65	1.4	-----	4,535
Lake trout.....	4,400	36	.8	-----	4,364
Landlocked salmon.....	790	87	11.0	-----	703
Rainbow trout.....	250	13	5.0	-----	237
Total.....	29,840	408	-----	8,300	21,132

The following table shows the number of each species on hand on March 1, 1907, and again on October 1, 1907, with losses and plants made during this period (7 months):

RECORD OF SANTA CRUZ HATCHERY, MARCH 1 TO OCTOBER 1, 1907.

Species.	On hand Mar. 1.	Deaths Mar. 1 to Oct. 1.	Distributed Mar. 1 to June 1.	On hand Oct. 1.
Quinnat salmon	4,635	4	4,135	496
Silver salmon	3,078	8	2,578	492
Sockeye salmon	3,580	47	3,078	455
Brook trout	4,535	25	693	3,817
Lake trout	4,364	57	983	3,324
Landlocked salmon	703	64	499	140
Rainbow trout	237	15	-----	222
Total	21,132	220	11,966	8,946

The Santa Cruz hatchery is supplied with water from two springs, which do not run more than 125 gallons of water per minute, at a temperature of 48° F. When the shortage of this water supply is considered, it is little less than remarkable that we were able to hold the large numbers of 6 months old fish (about 30,000, the greater number being Pacific coast salmon) which we had on hand November 1, 1906 (see first table), and have them in a perfect state of health on this date. In fact they were as healthy as possible on October 1, 1907, one year and six months after they were hatched. The very low death rate from November 1, 1906, to October 1, 1907, will be found by referring to the last two tables. The water supply of the Santa Cruz hatchery decreased greatly during the summer of 1907-8 (months of December, January, and February), and the fish on hand showing signs of disease, a number of each species were planted during these months.

On January 18, 1908, the fifth lot of eggs brought from the United States to Argentina left New York, numbering as follows: 300,000 quinnat salmon (*Oncorhynchus tshawytscha*), 104,000 sockeye salmon (*Oncorhynchus nerka*), 90,000 silver salmon (*Oncorhynchus kisutch*), 75,000 lake trout (*Cristivomer namaycush*), 75,000 brook trout (*Salvelinus fontinalis*), 30,000 rainbow trout (*Salmo irideus*), 15,000 landlocked salmon (*Salmo salar sebago*), and 3,000,000 cod (*Gadus callarias*). I personally had charge of this consignment of eggs to Southampton, England, being accompanied by Mr. Frank Brophy. The loss of the cod eggs was almost complete when we arrived in England, hence I determined not to attempt to take any of these farther. The loss of other eggs was very small indeed, having been less than one-half of 1 per cent from the time they were packed until put on board the steamship *Thames* on January 30, en route to Buenos Aires. The eggs were given over to Mr. Brophy's charge when this ship left her dock on January 1, and in addition to those already mentioned

he was given 20,000 Atlantic salmon eggs which were secured from the Earl of Denbigh's fisheries in North Wales. Mr. Brophy arrived with the eggs at the hatchery in Santa Cruz on March 1. The loss from the time of leaving Southampton until the eggs were unpacked at the hatchery was as follows: Quinnot salmon, a little over three-fourths of 1 per cent; sockeye salmon, a little over $1\frac{7}{10}$ per cent; silver salmon, a little less than nine-tenths of 1 per cent; lake trout, something over three-fifths of 1 per cent; brook trout, somewhat over two-fifths of 1 per cent; landlocked salmon, a trifle over $1\frac{1}{2}$ per cent; rainbows (youngest packed without moss) about $30\frac{3}{8}$ per cent; rainbows (youngest packed in moss), a little less than 64 per cent; rainbows (oldest packed without moss), $5\frac{3}{8}$ per cent; rainbows (oldest packed in moss), a trifle over $6\frac{1}{4}$ per cent; and Atlantic salmon 100 per cent. The total loss of the Atlantic salmon was due to imperfect packing, which was not discovered until after the eggs were all injured.

While the eggs that reached the hatchery alive appeared to be good, they were not as strong as a similar lot brought out for this hatchery from the United States and England two years previously, as will be seen by a comparison of the records. The death rate from the time the eggs were put into the hatching trays until they had finished hatching was in most cases rather high, as was also the death rate of fry during the month of March. The losses of eggs during the hatching period were as follows: Quinnot salmon, -9 per cent; blueback (sockeye), 30+ per cent; silver salmon, -14 per cent; landlocked salmon, 4+ per cent; brook trout, 34+ per cent; lake trout, 17+ per cent; and rainbow trout, -44 per cent. The losses of alevins during the month of March was as follows: Quinnot salmon, 5+ per cent; sockeye salmon -9 per cent; silver salmon 18+ per cent; landlocked salmon -63 per cent; brook trout, 10+ per cent; lake trout, -27 per cent; and rainbow trout, 100 per cent.

The lake trout from this hatchery and also the landlocked and sockeye salmon are planted in Lago Argentino and other bodies of water near by. The other salmon are usually planted in the Rio Santa Cruz and tributaries and Rio Gallegos and tributaries. The brook trout are planted in tributaries to the rivers mentioned, also in the tributaries of Lago Argentino and Lago San Martin. The rainbows (first lot of eggs) were planted in tributaries to the Rio Santa Cruz. Lago Argentino is supplied by several small rivers and streams which rise in the Andes Mountains, where there is ice and snow the entire year. The Rio Santa Cruz rises in Lago Argentino, which itself is situated in the Andes Mountains at an elevation of 2,500 to 3,000 feet above sea level, and is very deep. This lake has not yet been accurately surveyed, but is supposed to be 25 to 30 miles long at its greatest length and from 6 to 8 miles wide. It is in the Territory of Santa Cruz, which is the most southerly but one of Argentina.

On May 6 of this year I left New York with about 300,000 steelhead trout (*Salmo gairdneri*), these being the sixth lot of eggs to leave the United States for the Argentine National Government. These eggs were taken to Southampton, England, where 50,000 rainbow eggs from Germany were added to the consignment. They left England May 15, arriving in Buenos Aires on June 7, and at the La Cumbre hatchery on the 13th of the same month. The loss of eggs en route from the United States was very small, and not over 10 per cent on the rainbow eggs from Germany, this latter loss being entirely due to rough handling between Germany and England in the absence of any attendant. From England to the La Cumbre hatchery the loss was less than one-half of 1 per cent. The loss of the oldest steelhead eggs during the hatching was $6\frac{3}{4}$ per cent, mostly due to these eggs being a trifle too far advanced when shipped. The loss of the second oldest steelhead eggs during the same period was about $15\frac{1}{2}$ per cent, due greatly to the eggs being a trifle young when packed. The loss of the youngest of this lot of eggs while hatching was $18\frac{1}{4}$ per cent, due also, no doubt, mostly to the fact that the eggs were rather young for packing. There is, however, no way to avoid these losses on journeys of this length, as some eggs must be shipped when younger than others to guard against the possibility of the older eggs hatching en route. The loss of steelhead fry until they were six weeks old was 4 per cent. At this age they were as strong and healthy a lot of young trout as I have ever seen. All were feeding at this time.

The loss of the rainbows during the hatching period was about $10\frac{1}{2}$ per cent, and the loss of fry until six weeks old was $2\frac{3}{4}$ per cent. At six weeks of age these were all taking food, and were very healthy and strong.